June 1963

EMO

NATIONAL DIGEST

Do We Want Fallout Shelters

The Emergency Lodging Service

Continuity of Government

Population Under Nuclear Attack

Radiation Hazards Control

EMERGENCY MEASURES ORGANIZATION

THE EMO NATIONAL DIGEST

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In addition to publishing articles which reflect Canadian Government policy the Digest may also publish articles by private individuals on subjects of current interest to the emergency measures programme. The views of these contributors are not necessarily subscribed to by the Federal Government.

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DO WE WANT FALLOUT SHELTERS?

by SEVILLE CHAPMAN

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AS A NATION we must respond to the age of nuclear peril by developing a strong political and moral program for peace. Although there is no acceptable alternative to peace, the choice between peace and war is, unfortunately, not ours alone to make. Consequently, we must maintain deterrent forces and develop our military defences. Here the important issue of providing fallout shelters confronts us.

If you are inside most large buildings or in the basement below ground of most buildings or homes, your exposure to radiation is reduced to perhaps one tenth of what you would receive outside; this is a protection factor of 10. The Office of Civil Defense considers a shelter to be adequate only if its protection factor is 100, although in the absence of a good shelter, anything is better than nothing.

Few places have adequate shelters now. Therefore, communities must decide whether to spend money, often to match tax-produced government money, to build adequate shelters, and must also determine where and how to build them. The principal argument in favor of shelters is that they can save lives of many people, perhaps 90 per cent of those who would otherwise die. These people can work to rebuild civilization. The principal arguments against shelters are that they cost money and are undesirable for a series of what may be called emotional reasons:

It is said that no shelter can protect against a direct hit, which is true. But an elementary calculation shows that at least 99 per cent of the area of the country cannot be in the region of total destruction and that most people do not live in such areas. The most likely targets are military installations and possibly a few cities. Most cities probably will not be attacked, that is, if there is an attack at all.

It is said that there is no certainty in nuclear war, and because it would be the greatest tragedy of all time, it is to be avoided at all costs, without loss of human dignity. This is true too. Granted, your chances depend on the unknown attack plan, the unknown size of the weapon, the unknown distance you will be from the burst, the unknown weather. But is it so different from anything else in life? You estimate the chances (and while some people may be lucky or unlucky, the averages will work out); you consider the costs (in money, time, and effort) you determine what the advantages are of certain alternate programs (including none at all); you make your decision; and you, (individually or in concert with the community) proceed with your decision.

It is said that even if the shelter protects against radiation, there will be fires and you will die anyway. This is a good argument against bad or inadequate shelters, but for properly made shelters, it is not true. If there is enough concrete or earth around you to protect you for the few hours the fire is near you and if your shelter door can be tightly closed to prevent carbon monoxide from leaking in, then you may have a rather uncomfortable level of exhaled carbon dioxide inside a too warm shelter for a few hours, but you will survive until you can obtain fresh air. It is rather easy to filter out the radioactive dust. Perhaps there may be no fire near you; great fires are unlikely although not impossible in suburbs where there is less than 20 per cent overall roof area.

It is said that life would not be worth living afterwards in a devastated world. Granted, life would not be luxurious or easy, but it is not that way for most people even today. This country would have a lot of surplus food available, if it were stored properly. It would be arrogant to deny future generations the privilege of living as good a life as they can make for themselves.

It is said that new weapons will be more powerful than those of today and our shelters will be useless in a few years. To be sure, a new weapon may be discovered but it will have to be more than merely an extension of what already exists. It is quite unlikely that there will be a radically new operational weapon in ten years that would make today's good shelters obsolete. (This answer is incomplete, but it would take many pages to develop it more fully. It is an argument in favor of good rather than marginal shelters.)

It is said that war will not come anyway and money spent on shelters will be wasted. Even though his house may never burn, almost everyone insures his property against fire. If deterrence fails or if there is an accidental, escalated, miscalculated or catalytic war, shelters are insurance.

It is said that it is better to work for peace than to build shelters. There is good reason to do both. In the

sense that a country with shelters is less subject to blackmail, shelters contribute to peace.

It is said that shelters are provocative and may make it easier for belligerent elements in an enemy country to argue that we are about to start a war and they had better attack us before we attack them. Although a Polaris submarine lying off an enemy's shore ready to fire megatons in a moment is obviously more dangerous than a certain amount of concrete back in the U.S., there is a considerable body of informed opinion that says the Russians would interpret a massive shelter program as evidence of our war-like intentions, or that they might consider a modest program (say a billion dollars a year for ten years) as provocative. These arguments demonstrate that a shelter program should be presented in relation to our military budget of $40-50 billion a year, and that presumably appropriate arms control actions (such as a reduction of a corresponding expenditure on strike forces) should accompany a shelter program. As yet virtually no research has been done to support or deny this contention.

Because the public generally is confused about shelters, there is the major problem of informing people about the facts. First in a situation as complicated as defense against nuclear war, almost everything is true in some context and generally not true in a different context. Second, resulting situations and proper procedures are quite different in four distinct types of areas: ground zero areas, target areas, remote areas and fringe areas. The implicit neglect of this second point has been the root of much confusion.

A *ground-zero area* is a region within a mile or two of where the weapon goes off. It does not matter what kind of a shelter you are in; the shelter and you are both destroyed.

A *target area* is a region from about one to say three or five miles from a target. In such an area the situation is simple. Either you are in a high-grade shelter when the bomb goes off (and unless there is warning probably you won't be in one) or all your problems vanish. Fortunately only a very small fraction of all our people live in ground zero or target areas.

A *remote area* is one more than 50 or 100 miles from a target. In such an area the shelter problem is rather simple. There will be at least an hour, and probably several hours, of confirmed warning. No structures like houses will be damaged and there will be no serious injuries. Elaborate fallout shelters are not needed. School auditoriums, large buildings, store basements, and home basements below ground may be adequate as they are or with minor modifications. Generally speaking, fire is not a problem (although in some places like California with no summer rains, this may not apply). Practically all you have to do is get into a rather modest shelter (since the radiation will have decayed considerably, perhaps by five or ten times, before it reaches you) and then after an appropriate time, a few days or more, come out and begin the difficult job of getting the country going again.

A *fringe area* is one of 50 to 100 miles beyond the target area. There is really no precise range for each area, since it depends on the yield of the weapon. In a fringe area, what happens to you depends critically on what kind of protection you have. Fallout may arrive in ten minutes to an hour. If you have no protection, almost surely you will perish; if you have good protection, almost surely you will survive. One of the things important in a fringe area is to avoid the trap of providing inadequate shelter, such as the ridiculous do-it-yourself, walk-in, family-playroom fallout shelter. The cost of a good family shelter for a fringe area per person can be four to six times that of the equivalent community-type shelter for 100 persons or more.

The U.S. Navy Radiological Defense Laboratory has constructed an underground shelter for 100 people like an ammunition storage magazine. It looks something like an underground quonset hut. Families have lived in it for several days; 100 men have lived in it for two weeks. It costs about $100 per person, depending on whether sleeping is done in one shift or three, the degree of blast protection and the degree of ventilation for overcrowding, etc. The best version provides blast safety beyond two miles from a five-megaton ground burst, complete fire protection, ventilation for double the rated number of people, and excellent fallout protection with a factor of 10,000.

The criteria for a good shelter relate to fallout protection; protection against chemical, biological, and radiological weapons; blast protection; fire protection; auxiliary power and fuel for filtered ventilation, light, and communication; accessibility and location in the community; water and food; sleeping facilities; sanitary facilities, including public health facilities; medical supplies, especially for burns, cuts from flying glass, radiation sickness, and hysteria; radiation monitoring instruments; discipline; recreation; spiritual guidance.

A serious problem arises if there is not enough shelter for everyone. There is only one good answer to this problem, and that is to have enough shelter for everyone. If one shelter is overcrowded, after a day or two when the radiation has decayed greatly (in two days to one per cent of the value an hour after the burst), a number of people can make a quick trip to another shelter that is less full.

In typical fringe areas, where shelters can make a lot of difference, there is the question of community

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THE EMERGENCY LODGING SERVICE

The Emergency Lodging Service is one of the five Emergency Welfare Services. The term 'emergency lodging' describes the use of existing dwellings, commercial lodging establishments, and other buildings to provide temporary accommodation to persons in need, due to a war emergency.

Why An Emergency Lodging Service

ONE OF THE MOST critical problems which would have to be faced in a nuclear war would be that of finding temporary accommodation for the homeless. The blast and fire effects of a nuclear weapon could either destroy or severely damage a very significant percentage of property. Radioactive fallout could render other large areas uninhabitable, at least temporarily. Vast numbers of evacuees could be literally thrust upon undamaged communities with little or no warning.

The need, when it came, would be both immediate and acute and would have to be met by surviving urban communities and rural areas. Initially the burden would fall on those communities unaffected by fallout, within reasonable travelling distances from the stricken area. To meet the immediate need, all available space in private homes, apartments, hotels, and motels would be strained to capacity. Other buildings, never designed for living, would have to be organized for group occupancy. Later, as time and circumstances permit, there would have to be a redistribution of evacuees to farther reception areas.

The success in meeting the need for emergency lodging will depend on the preparations which have been made by all levels of government in all parts of Canada.

Use of Existing Buildings

In meeting the accommodation needs of evacuees, the Emergency Lodging Service would have to rely largely on existing private homes and apartments, hotels, and motels. Not only do these buildings represent our largest lodging resource but they are designed for living. They would be ready for occupancy because they contain beds and blankets, kitchens and cooking equipment and have water, heat and sanitary facilities. In addition, a large percentage of homes have basements which would offer some protection against fallout, to both residents and evacuees.

However, statistically only 26.3% of the dwellings in Canada are in urban areas outside probable target areas. Therefore, even with the addition of commercial lodging establishments there would be serious overcrowding.

Congregate Facilities for Special Groups

For those evacuees having special needs such as children separated from their families, the aged and infirm, and welfare institutional groups, congregate lodging facilities would be required. This would necessitate the adaptation of certain other buildings, such as church and lodge halls and schools, to dormitory type accommodation. Such buildings would have to be usable without structural alteration and would require light, heat, water, toilets, essential supplies and equipment.

The Lodging Survey

To operate the Emergency Lodging Service it would be necessary to carry out a lodging survey to record the specific space and facilities available in each structure. Also, since the duration of the emergency cannot be anticipated it is necessary to have some information about the householders with whom evacuees would be placed.

The aim and scope of the survey is to produce tabulated information about lodging resources in the community. More specifically the:

(*a*) Number of rooms in each dwelling and commercial lodging establishment.

(*b*) Area of usable space in other buildings.

(*c*) Water, toilets, electricity, gas and heat in those structures.

(*d*) Fallout protection factor of basements and usable space therein.

(*e*) Personal information about the householders.

An index of this information relating to private homes and apartments is set up by completing Lodging Facility Card—Dwellings, reproduced in figure 1. The specific data in respect to other buildings is recorded on the Lodging Facility Card—Commercial and Congregate, shown in figure 2.

Sources of Information

Details of the total number of rooms in the community are available from the 1961 Canadian Census (Housing), and would be helpful in planning a survey.

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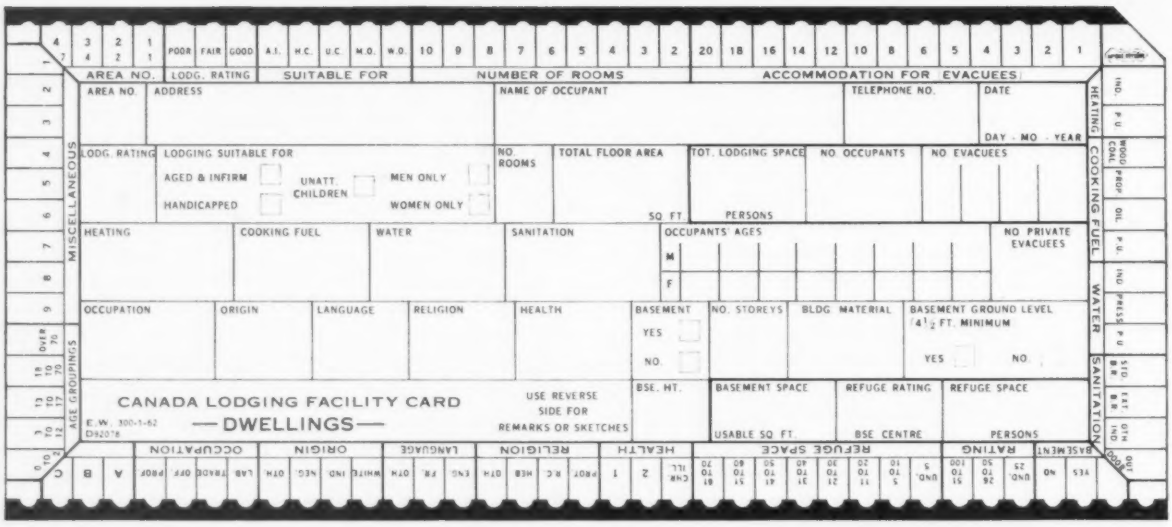

FIGURE 1

AREA	DATE (Day Mo. Year)	TELEPHONE NO.	ADDRESS OR LOCATION	NAME AND TYPE OF BUILDING	CIVIL DEFENCE USE

BUILDING MANAGER	TELEPHONE NO.	ADDRESS OR LOCATION	RATING	TOTAL USABLE AREA	TOTAL LODGING CAPACITY
				Sq. Ft.	Persons

COMMERCIAL (Hotel – Motel)	CONGREGATE (School, Hall)	BASEMENT	BASEMENT AREA	HEIGHT	GROUND LEVEL	REFUGE RATING	REFUGE SPACE
No. Regular Guest Rooms	No. Rooms	Yes ☐ No ☐	Usable Space ÷40		4½ Ft. Minimum Yes ☐ No ☐		Persons
Regular Guest Capacity	Total Lodg. Area Grd. Fl. and Up Sq. Ft.		Lodg. Space For				
Emergency Capacity							
Other Lodging Space Sq. Ft.	No. Separ. Offices						
Separate Office Space Sq. Ft.	Total Office Area Sq. Ft.						

STAIRWAYS	ELEVATORS	LIGHTING	FIRE RATING	NORMAL OPERATING STAFF	PARKING SPACE
No. Width	No. Size	P.U. ☐ Auxil. ☐ Indep. ☐	Good ☐ Fair ☐ Poor ☐	Type / No.	Area / No. Cars

WATER SUPPLY	SANITATION	HEATING	FEEDING FACILITIES	LODGING ASSIGNMENTS
P.U. ☐ Well ☐	Sewer ☐ Septic Tank ☐	Central ☐ Stove ☐	No. Stoves ____ Burners ____	Total Space
Indep. Press System ☐	Flush Toilet ☐ Chem. Toilet ☐	Space Heater ☐ None ☐	Fuel	Date / No. / Balance
No. of Outlets	Other Indoor ☐ Outdoor ☐	Fuel	Elect. ☐ Coal ☐	
Basements	No. of / Base. / Oth. Floors	Elect. ☐ Nat. Gas ☐	Propane ☐ Wood ☐	
Other Floors	Toilets	Oil ☐ Wood ☐	Nat. Gas ☐ Oil ☐	
H & Cp ☐ Cp ☐	Urinals	Coal ☐ Other.	No. Refrigerators	
No Piped Water ☐	Sinks	Sufficient Winter Heat	Normal Meal Capacity	
	Baths	Yes ☐ No ☐		
	Showers			

CANADA EMERGENCY WELFARE SERVICES — LODGING FACILITY CARD — COMMERCIAL AND CONGREGATE

EW–310–1-62

Use Reverse Side For Remarks and Sketches

FIGURE 2

However, the detailed information required will be obtained for three main sources.

(*a*) Municipal assessment and building records.
(*b*) The physical examination of commercial and congregate type buildings.
(*c*) A house to house canvass of the dwellings in the community.

Preparations

Whether the survey is to be made of urban or rural areas, certain basic preparations are necessary:

(*a*) The communities must know how many evacuees they have been allotted in the Provincial Plan.
(*b*) Approval must be obtained for access to local assessment records.
(*c*) Staff must be recruited and briefed.
(*d*) Publicity will be needed to prepare householders for the canvass.
(*e*) Supplies of Facility Cards and equipment must be obtained.
(*f*) Questionnaires and work sheets must be prepared.

Public Information

While the primary aim of the survey is to create an operational capability in a community, it also provides an opportunity for public information concerning not only the Emergency Lodging Service but the entire Emergency Welfare services programme. It affords a specific task for which to recruit workers for the Emergency Lodging Service and a built in opportunity to train them.

Methods of Measurement

A reception community does not have a constant lodging capacity. Although actual lodging space is constant the capacity is determined by the number of people to be lodged. Dwellings and commercial establishments are measured by number of rooms, exclusive of kitchens and bathrooms. Other buildings are measured by the usable square feet of floor area. The calculation of fallout protection space is more involved since it is necessary to ensure that allowance is made for air space as well as floor area. Fallout protection space is therefore measured in square feet if the basement is at least seven feet high or in cubic feet if under that height.

The number of persons including evacuees, to be lodged per room in dwellings and commercial establishments is determined by dividing the total number of persons by the number of rooms available. This produces the assignment ratio. The space in other buildings is allotted for planning purposes on the basis of 40 square feet per person.

In fallout protection space, depending on the height of the basement, 12 square feet of floor area or 80 cubic feet is allowed per person.

This system of measuring and allotting space is sufficiently flexible to permit rapid adjustment in the emergency period in accordance with an increased or decreased demand.

Emergency Lodging Operation

The assignment of evacuees to emergency lodging would be a human rather than a statistical operation and the accommodation as adequate as the crisis circumstances would permit. Inconvenience, discomfort and nervous tensions could not be avoided when evacuees and householders live together under crowded and unfamiliar circumstances. However, efforts must be made not to aggravate these natural problems, by adding such difficulties as would arise if there were serious language differences, for example, or if the very young were placed with the very old.

Evacuees will be directed to Welfare Centres upon arrival in reception communities. After the heads of families or individuals have received whatever other emergency welfare services they require they will complete Lodging Assignment forms. Accommodation in the Welfare Centre area will be selected from the Facility Card index. The assignment officers will have the final decision as to placement. They will endeavour to match the available accommodation with the special needs of the evacuees. Family units will be kept together even at the expense of overcrowding some dwellings. Persons requiring special care would not be referred to the Emergency Lodging Service but would be taken to prearranged congregate facilities.

In pre-attack evacuation with large numbers of evacuees arriving, speedy placement would be of paramount importance. Emphasis would be on selecting accommodation with some protection against fallout. In the post-attack phase more attention to individual cases would be possible. With fallout threatening or present all placement procedures from Welfare Centres would be suspended and the efforts of the entire EWS would be directed to providing safe cover for residents and evacuees alike.

The precision called for under ideal assignment conditions will obviously not always be possible, therefore, the plan and the organization must be flexible enough to provide a framework and a discipline adaptable to varying conditions.

The Municipal Organization

In operations the Emergency Lodging Service would be using the real estate of a given area. Householders

would be required to share their dwellings and authority would exist to make use of other buildings necessary to meet emergency demands. It is therefore essential that the Emergency Lodging Service be conceived and developed within the framework of municipal government.

A chief of Emergency Lodging must be appointed and trained at the outset and he should be a municipal employee experienced in the housing or lodging field. His responsibilities will include:

(*a*) Selecting a Planning Committee.
(*b*) Developing a tabulated index, using Lodging Facility Cards, of all lodging resources in the community.
(*c*) Producing a written plan for the use of these resources in an emergency.
(*d*) Appointing, training and exercising staff to implement the plan.
(*e*) Operating the Service in an emergency.

All suitable buildings in the community cannot be earmarked for lodging use. There will be requirements for Welfare Centres, Emergency Health installations and others to be met from existing resources. The initial allocation of buildings will therefore be made by the Municipal CD Co-ordinator, following the survey, and after consultation with the EWS Director.

The physical locations in the community from which EWS would be administered are the Welfare Centres which serve geographically defined Welfare Centre Areas. In all but the very small communities there will be more than one such centre established. The total number of evacuees being planned for will be distributed among the Welfare Centres according to the number of present residents per room in the area, and the emergency assignment ratio for the community. For example: if there are 1,500 residents and 1,700 rooms in a Welfare Centre Area and the emergency assignment ratio is 3 persons per room, there would be space available for 3,600 evacuees and the 1,500 residents.

Each Welfare Centre will require a Lodging Supervisor and staff consisting of: assignment officers responsible for selecting accommodation for the evacuee family or individual; lodging leaders under whose instruction Assignment Forms would be completed and aides to perform clerical duties as required. The number of personnel required will depend on both the extent of the lodging resources and the number of evacuees to be processed. All staff must be taught the skills and techniques necessary to assign evacuees.

Responsibility of Zone

A zone is comprised of an aggregation of administrative areas such as municipalities, counties and townships. A Chief of Emergency Lodging is required at zone level in peacetime to encourage and assist in the development of an emergency lodging capability in reception areas. The responsibilities of Chiefs include:

(*a*) Assisting in the organizing of reception areas.
(*b*) Interpreting policy and procedure for Municipal Chiefs.
(*c*) Providing technical assistance and advice in surveys, training courses and exercises.
(*d*) Developing a Zone Lodging Plan.
(*e*) Operating the service at zone level in an emergency.

Provincial Responsibility

While the administration of an Emergency Lodging Programme is a municipal responsibility, direction both in peacetime planning and wartime operations rests with Province. To provide this direction a Provincial Chief of Emergency Lodging is appointed. His responsibilities include:

(*a*) Creating operational units at zone level.
(*b*) Developing basic policies and procedures for province-wide application which will ensure uniformity and economic use of lodging resources.
(*c*) Establishing a training programme for Emergency Lodging personnel.
(*d*) Preparing a Provincial Lodging Plan.
(*e*) Operating the Emergency Lodging Service in the province in an emergency.

Federal Responsibility

Arising out of the federal Civil Defence Order, 1959, the following responsibilities have devolved upon The Emergency Welfare Services Division of the Department of National Health and Welfare:

(*a*) Provision of advice and assistance to provinces and municipalities in planning, organization and operation of the five Emergency Welfare Services; lodging, feeding, clothing, registration and inquiry, and personal services.
(*b*) Co-ordination of the total welfare effort in Canada in an emergency including advice on the best use of federal welfare resources and co-ordination of assistance between provinces, national organizations and the U.S.A.

A great deal has been done in the lodging field at federal level to assist provinces:

(*a*) A pilot lodging resources survey to train provincial staff has been carried out at Federal expense in each of five provinces, the last at Kamloops, B.C. in August 1962.

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CONTINUITY OF GOVERNMENT

By J. F. WALLACE

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Introduction

THE FIRST STEPS in the field of continuity of government were undertaken in June 1957 when the Emergency Measures Organization was created for the specific purpose of developing a plan which would ensure the continued operation of the federal government in the event of nuclear war. In the same year, some aspects and principles which are related to the programme known as continuity of government were introduced into the Civil Defence Planning Courses in Arnprior. However, it was not until the reorganization of civil defence, at the federal level in 1959, that the term came to have special significance to emergency planners, not only at the federal level but at all levels of government. Today the real meaning of the term in some instances has been lost and some have even used the term in the sense that it is meant to imply the protection of selected individuals in government. Nothing could be further from the truth! Possibly our North American habit of trying to shorten our terminology has resulted in having the term sometimes given unintended shades of meaning and emphasis.

Continuity of government would probably have been better understood if it had been more fully emphasized that the new programme was aimed at ensuring the continued operation not only of government authority but also of essential government services during periods of emergency. Looked at in this way the programme does make sense, because it is then related to the preservation of such vital services of government as the maintenance of law and order, public health, and so forth. As well, it is related directly to the continuation of such economic activities as production of essential commodities. Therefore, all of the programmes for continuity of government are directed to the one aim—the survival of the population.

Since 1959 continuity of government has been receiving considerable attention by all levels of government—federal, provincial, and municipal. Previous to 1959, most of the activities which were involved in emergency planning were those which related directly to the survival of people; for example, the organization of rescue services, the development of warning systems, the problems of pre-attack evacuation and reception. During that period, little attention was given to the problems of ensuring the continued operation of government.

The effect of the 1959 reorganization

With the reorganization of civil defence in 1959, the Emergency Measures Organization was given the task of co-ordinating the total civil emergency planning programme of the federal government, as well as providing assistance and guidance to provincial governments, and through them, to local governments. In effect, it was from this time on that the federal EMO commenced the direction of what was really to become a two-pronged programme of civil emergency planning. The first was related to the continued operation of essential government services. The second was the provision of advice and assistance on programmes which would assist the population in surviving the possible effects of nuclear war. These latter programmes really absorbed what were, and are still, widely known as civil defence programmes.

From the point of view of organization and planning at the federal and provincial levels of government, it is a relatively simple matter to look at these two aspects of civil emergency planning in isolation, but, in fact, and particularly at the local or municipal level of government, these two programmes are so closely intertwined that they really cannot be separated. At the provincial level, of course, survival matters such as evacuation routes and reception areas, need particular emphasis.

Provincial Plans

Most persons readily recognize and agree to the importance of having the federal government make advance preparations for possible war emergencies. However, many forget or neglect to consider that the preparations which are made by provincial governments are just as important and necessary. In many cases, although federal powers or controls may cover some important task or function, it is in fact provincial government departments which will use many of these powers to implement the national policy.

Similarly, although the federal government may be responsible for the creation of controls in such an area as food supplies, most of the staff for such a programme would be drawn from provincial government departments and private industry. Additionally, there are areas, such as in the fields of law and order, health and welfare, in which provinces have complete responsibility, and federal officers in these related areas of interest will be used by the provincial governments. The plans which are developed by federal and provincial governments are intended to be complementary.

Local Plans

The whole concept of organizing, in peacetime, public services within municipalities is based on the principle that such services are needed and must be provided for the common good. During times of disaster or emergency, it is vitally important that these selfsame services of local government be organized in such a manner as to ensure that elected leadership continues. During this century, in Canada, there has been ample evidence arising out of major 'natural' disasters to support this contention. In times of stress, the people automatically turn to their respective governments for guidance and assistance. Therefore, it is important, when the scale of devastation which could be brought about by nuclear explosions is so great, that positive steps be taken by all local governments to be in a position to provide this leadership. Otherwise, the country would dissolve into the morass of chaos.

Relationship of Continuity of Government to Public Survival

Most of the publicity which has been devoted to emergency planning activities in Canada has tended to be concentrated, and rightly so, on matters which directly affect the personal survival of individuals; for example, sirens for warning the population, pre-attack voluntary evacuation of more likely target areas, and fallout shelters, as well as the vitally important life-saving role which has been assigned to the Canadian Army. At the federal level, the continuity of government programme, apart from making arrangements for the preservation of the processes of government, has been devoted to many very important matters which are indirectly related to the survival of the population. For example, the Emergency Supply Planning Branch in the Department of Defence Production was specially created to develop the plans which will ensure that essential supplies, such as food, clothing and fuel, will be available to the surviving elements of the population on an equitable basis.

Planning Effective Controls

Many Canadians are generally aware of the controls, e.g. those on gasoline, sugar, food, etc., which came into existence during the Second World War—a war in which Canada was not subjected to the effects of direct attack. There is sufficient evidence to indicate that, should a global nuclear war take place and Canada be attacked, it would be most important that adequate controls and safeguards be taken immediately the emergency occurs by the federal government to ensure that the country is dealt with as a unit. In blunt terms, this might be looked on as a policy of sharing the misery with one another! Because it is entirely conceivable that the outbreak of such a war would be swift, there would be no time, as there has been in past wars, to build up our systems of control. It is for this reason that emphasis has been placed on the necessity for developing the plans, organizations, and procedures which will enable all levels of government to take appropriate action without delay or confusion.

Necessity of Tests and Exercises

Emergency planners, because they really work in an area in which there are many imponderables (no one really knows very precisely what a nuclear war would be like), welcome opportunities to exercise, study, or test their prepared plans. The primary purpose of exercises and studies is to analyze those plans which have been prepared so as to point out gaps or weaknesses in them. The past three national exercises (TOCSIN Series) have been of inestimable value from this point of view for the federal and provincial governments. At the local or municipal level of government, hundreds of small scale exercises or studies are conducted each year to analyze the local aspects of the problems of national survival. Such exercises do not necessarily involve the large scale movement of people or machinery, and consequently the public is usually unaware of this important activity.

Emergency Assignments

As pointed out earlier, in the past and during the second world war civil defence organizations were developed primarily to look after measures which directly affected the population, and there was an unfortunate tendency, particularly on this continent, to divorce such organizations from normal processes of government. However, the scale of damage which was anticipated then was such that these organizations might have been able to operate effectively. But with the advent of the megaton nuclear weapon, it was quickly recognized that the scale of disaster would

require that the total resources of government and industry would have to be applied.

There are many departments and agencies at all levels of government which would have important roles to play in any major disaster, and it is necessary for such departments or agencies to make their emergency plans in times of peace. In other words, emergency planning is the peacetime responsibility, at the federal and provincial levels, of many departments of government. There are many other departments or agencies at both levels of government which have important peacetime responsibilities but which, during a period of nuclear war, would not be vital to the survival of the country. The resources of such departments are tapped by those which have definite responsibilities during an emergency, in order to build up the latter's operational capability. Similarly, at the local levels of government, some departments and agencies have specific emergency roles and some have not. At this level particularly it is important that emergency organizations have a capability to respond with minimum delay to likely disasters or emergency situations. Hence, the need to base the various emergency organizations on a department of local government which, in most cases, has related peacetime responsibilities.

Procedures Being Followed

When the emergency roles have been assigned to departments at each level of government, there are certain rather prosaic procedures which must be followed to develop an operational capability. These procedures are common to all levels of government. They are time-consuming to the emergency planner, but they are vital to the development of the emergency operational capability of the departments concerned. A brief summary of the more important of these procedures is as follows:

(1) The designation of the key officials, officers and employees who will be responsible for the direction of the departments' operations during the emergency. As well, departments are responsible for establishing lines of succession of authority of key officials and officers in order that authority be preserved within the department.

(2) The selection of the essential records of the department. Of the many records which are in existence within a department, a select few, which would be vital to the operation of the department during an emergency, should be stored in safe locations, probably in emergency government centres.

(3) The preparation of whatever emergency orders, regulations and legislation may be required by a department.

(4) The determination of the emergency functions that would be the responsibility of the department.

(5) The selection of a place from which emergency government can operate during the period of an emergency. Such locations must provide those occupying them with protection against fallout.

(6) The development of manning plans. Such plans inform each key official, officer, or employee on how, and when, he is to report to his place of emergency duty.

(7) The development of an informational programme for the benefit of all employees of the department, whether they have been assigned emergency tasks or not. Such programmes, in addition to providing employees with basic survival information, would outline for the benefit of the employee what specific actions he should take in the event of a National Alert being sounded while he is at his place of normal work.

(8) The conduct of a resources survey. Each department is responsible for the tabulation of the resources which are normally available to it for carrying out its emergency tasks. The tabulation, depending on the type of resource being assessed, should be in a simple graphic form which can be put to use immediately a disaster takes place.

(9) The preparation of a departmental plan for emergency operations. The plan which is developed will be based on the information derived from the first eight procedures mentioned above. Such departmental plans, in their development, will have to be assessed in relation to the plans of other departments or agencies so as to ensure adequate co-ordination of the emergency government operation. This task of co-ordination is, or should be, one of the prime responsibilities of the Emergency Measures Organization at each level of government.

Role of Emergency Measures Organizations

If organized in accordance with the concepts of planning outlined here, an emergency measures organization is in reality an agency whose main purpose is to encourage the development of emergency plans by departments and agencies of government. The EMO should be made responsible for the co-ordination of all departmental plans. Consequently, it should not be assigned the task of developing plans which are, or should be, the responsibility of a specific department of government which, in an emergency, whether prepared or not, would be expected to operate. It is of interest to note that in the event of a national emergency, the Federal Emergency Measures Organization

would, in effect, cease to exist as a functioning organ of government. At such a time all its available personnel would assume previously assigned tasks in other branches of emergency government.

In provinces and municipalities, the same process should take place. If the Emergency Measures Organizations have done their job in peacetime, then their trained personnel should become part of the executive arm of the government they have previously served. It is recognized that there are important functions or emergency tasks which will have to be carried out for which there is not, in peacetime, an appropriate department or agency of government to whom the task can be assigned. Therefore, one finds that local emergency measures organizations become responsible, in peacetime, for the organization (on behalf of the municipal government) of such important emergency services as—emergency communications, wardens, rescue, radiological defence, public information. However, if these services have been organized properly, then in an emergency they become, or should become, another operating agency of government, such as the police, fire, health, engineering, and so forth.

Responsibility of Civil Government

Too often in the past many people have visualized the Emergency Measures Organization, or the Civil Defence Organization, as THE organization which will direct operations in an emergency. Such a view loses sight of one of the main purposes of emergency planning, that is the preservation of civil government and the responsibility of civil government to carry out its commitments even during the period of disaster. Acceptance of this purpose is in complete accord with the basic principles on which western society has been established. Government is established to direct those matters which government can best carry out for the common good.

Some Steps Have Been Taken

Before concluding this article, it may be useful to summarize briefly some of the steps which have been taken at the federal level to ensure the operation of government in an emergency:

(1) Seventeen departments or agencies of government have been given emergency tasks. Key people have been assigned to carry out those tasks. Each of these departments or agencies has a small staff which is primarily concerned with the ultimate development of departmental emergency plans, as well as keeping up to date the plans which have already been developed.

(2) There have been created in six provinces, (and planned for in the others) emergency government centres from which representatives of federal (including Army) and provincial authorities will be able to direct survival operations (*see also* Vol. 1 No. 1 *EMO National Digest*). In those provinces which do not have permanent emergency headquarters, interim facilities are available.

(3) Emergency orders and regulations which would be necessary to empower government officials to be able to carry out their emergency tasks have been prepared, and are under constant review. Some of these orders and regulations permit the creation of the following:

   (*a*) A War Supplies Agency for the control, distribution, and production of essential commodities (*see also* Vol. 1 No. 3 *EMO National Digest*).

   (*b*) A Wartime Accommodation and Construction Agency for the purpose of ensuring that available housing and other accommodation will be used to the best advantages.

   (*c*) A National Manpower Authority to ensure that the best use will be made of available manpower during the period of the emergency. (*see also* Vol. 3 No. 2 *EMO National Digest*).

   (*d*) A Road Transport Control Organization to co-ordinate the use of commercial fleets of buses and trucks (*see also* Vol. 1 No. 5 *EMO National Digest*).

(4) Outside of Ottawa a number of sites have been constructed which will serve the central government in providing the necessary direction and co-ordination for national survival.

Conclusion

In conclusion, there are at least five salient points which arise out of civil emergency planning, and, in particular, out of the arrangements for the continued operation of government during emergencies:

- the emergency plans prepared by government must have a continuous capability of being implemented instantly;
- civil defence is in reality total government in action during an emergency;
- emergency planning in peacetime cannot be divorced from the everyday activities of government, and is a continuous process;
- emergency planning responsibilities that are inherently the responsibility of a particular department of government cannot effectively be assigned to other agencies of government;
- plans for the survival of the population cannot be developed in isolation from the plans for the continued operation of government. ▲

POPULATION UNDER NUCLEAR ATTACK

The following article consists of extracts from a paper, DEMOGRAPHIC FACETS OF NUCLEAR WARFARE, *which was presented to the Population Association of America at Madison, Wisconsin, on 4 May, 1962. The author is Dr. Joseph D. Coker, Director of the United States National Resource Evaluation Center, Office of Emergency Planning. An article by Dr. Coker,* RESOURCE EVALUATION FOR EMERGENCY PLANNING, *appeared in the August 1962 issue of* EMO NATIONAL DIGEST.

Population as a Target in Nuclear Warfare

THERE are a number of variables that must be taken into account when we try to estimate the effects on population of hypothetical nuclear attacks. One of these variables is target selection. There has been much speculation and controversy over whether an adversary would select the enemy population per se as a target. Let us examine a few considerations which might prompt an adversary to select population targets and also some considerations which might lead him to ignore or even to endeavor to avoid population in his target planning.

Perhaps the most common reason for assuming that population targets will be selected for attack is the argument that such attacks will greatly decrease both the capacity and the will of the attacked nation to support a long-term continuation of the war. Even if elements of the enemy's nuclear striking force are the primary targets, it is frequently held that concurrent or follow up attacks on population will provide further insurance of eventual military victory.

The importance of such insurance to a belligerent will depend upon his information concerning the location and vulnerability of the enemy's nuclear striking force, upon his confidence in the accuracy and completeness of this intelligence, and on the probability that these forces can be destroyed before they are alerted and moved to places of safety. Any weakening of his confidence in his ability to destroy the enemy nuclear delivery capability, will increase his inclination to select other targets, perhaps including population targets. Here we must face the paradox that the very measures which might reduce the overall likelihood of attack upon the U.S. could increase the probability that population and other non-military targets would be hit if, in fact, an attack should occur. I am thinking in particular of measures to reduce the vulnerability of our retaliatory striking forces by hardening their facilities, by maintaining more airborne ready forces or by placing more emphasis on mobile weapon launchers such as the Polaris submarines.

Another argument supporting the probability of attacks on population is that an adversary may wish to eleminate or greatly reduce the enemy population because he believes this enemy population to be an obstacle to his occupation and utilization of the enemy territory and resources.

Still another theory that is advanced as a possible basis for selection of population as a target, applies not to the aggressor but to the country that has been attacked. According to this theory, an adversary which has been attacked will strike back against the enemy population in revenge. This theory is sometimes extended to the case in which an adversary will launch an attack in anger against the enemy population under circumstances where he believes correctly or incorrectly that the enemy has launched an attack.

Next, I shall outline some arguments for the position that population per se will not be attacked. The most frequently used case for the view that population will not be a target has already been implied. It is that any adversary will wish to be as nearly certain as possible that he will destroy his enemy's nuclear striking forces. He would therefore concentrate his nuclear effort on these forces so as to insure that they will have a minimum capability to damage him. There are other somewhat more sophisticated arguments. One of these is that, at this point in history, only mad men would intentionally initiate a nuclear exchange with populations as targets; that, if nuclear war should be fought, both sides would wish to keep it a controlled nuclear war with limited objectives, and that each

side would avoid attacks against enemy population centers out of fear of retaliation in kind.

Another theory, held by Herman Kahn among others, is that an attacker will try to spare the enemy population, at least initially, in order to use this population as a hostage and thus accelerate pressure for early surrender. Imagine a situation in which, after an attack limited to our military forces, enemy aircraft should scatter millions of leaflets among us stating "You have been disarmed. You will now surrender or we shall wipe out your cities." To many, this would sound quite convincing. Still another and perhaps more distressing possibility is that an enemy may choose to minimize injury to population in order to exploit it as a labor force.

My own views are that, in the event of a nuclear exchange, population per se is unlikely to be a target. I hold that, in addition to nuclear force targets, it is more likely that carefully selected industrial facilities will be attacked. However, because the population of the U.S.A. is concentrated so largely in the same general areas as is its industry and as are many nuclear force targets, it is not feasible to develop an attack strategy which could achieve neat distinctions. Because the damage and casualty radii of nuclear weapons are now so large, any attack on the U.S.A. would also undoubtedly produce very heavy casualties to the population—whatever might be the precise strategic intent of the enemy. Accordingly, my inclination is to put aside any detailed discussion of the various theories just outlined and focus attention instead upon the methods of estimating impact on population of various types and weights of attack.

Estimation of Direct Attack Effects on Population

The National Resource Evaluation Center has as its principal aim the development of better bases for selection, planning, implementing and testing non-military defense strategies. NREC is established as part of the Office of Emergency Planning in the Executive Office of the President, but it is staffed with personnel from approximately 20 federal departments and agencies which have major emergency responsibilities.

NREC has developed both electronic computer techniques and compatible manual techniques for casualty and damage assessment and for resource evaluation. As I am sure you realize, there is great interest in the probable nuclear attack effects on population and on many types of resources in many places and at many levels in government. Also, the data processing job required for estimating effects on all these people and resources and for spelling out the implications is very massive, indeed. Thus, it is easy to see why we have placed heavy emphasis in NREC on computer methods and applications. Whether computer methods or hand methods are used, however, four general types of information are required for casualty assessment and resource evaluation related to nuclear attack: (1) data on quantities, location, and vulnerability of people and resources, (2) weapons effects factors, (3) attack data, i.e., location, size, height, and time of each detonation, and (4) meteorological data.

The National Resource Evaluation Center, largely through the support of participating government agencies, maintains data on population and almost every type of resource considered important to survival and recovery. At present we are keeping track of some 550,000 "resource points" in the United States. Separate population estimates have been entered into the NREC magnetic tape library for each of approximately 43,000 area elements which are derived from individual Census tracts and sub-tracts within the United States. In the most heavily populated portions of cities, these areas consist of only a few city blocks. Sparsely populated areas are, of course, far larger.

In the NREC casualty assessment procedure, the computer calculates the distance between the center of each of the 43,000-odd areas and the point of detonation of each weapon close enough to have any blast or thermal effect upon the population of that area. Then, in each case, fatalities and other casualties resulting from blast and other direct effects are estimated by use of formulae which relate the expected percentage of mortalities and other casualties to distance from the detonation points of nuclear weapons of applicable sizes.

Although present NREC procedures provide estimates of casualties by direct thermal radiation and radioactive fallout, they do not yet provide estimates of casualties from spreading fires which may follow a nuclear detonation. A new computation model, called "Flame", now almost complete, will estimate the extent and the effects of spreading fires.

Probable Ranges of Direct Attack Effects on Population

As a basis for describing attack effects I shall assume that a nuclear attack will be made on the U.S. My repeated use of the verb "will", in describing the resulting post-attack situation is based simply on that assumption. It does not mean that I believe there will be any such attack. Quite the contrary, I happen to believe that there will not be a nuclear exchange—unless irrational

persons gain control of nuclear weapons or unless there is a serious miscalculation or accident.

If we assume there is a nuclear attack, the number of deaths and other casualties will depend on many factors among the most important of these are the targeting doctrine employed, the scale or total weight of the attack, the percentage of surface bursts, the fission-fusion ratio, yield and distribution of weapons, and the degree of population protection achieved (which in turn depends upon the shelter available and on warning, training, and human response.)

A few rough approximations can be provided. If an attack totaling 1000 megatons (with ⅓ fission yield) is aimed exclusively at U.S. air bases, total fatalities will approximate 10% of the U.S. population. The same weight of attack designed to maximize fatalities will kill approximately 40% of the population.

If the weight of attack is increased to 5000 megatons, an attack aimed at air bases will produce about 50% fatalities while an attack of equal weight designed to maximate fatalities will kill about 80% of the population. A 10,000 megaton attack would drive these fatality estimates up to about 75% and 95% respectively. A 50,000 M.T. attack would kill almost all U.S. citizens under either targeting assumption. All of these estimates are based on presently available shelter.

The relationship between the number of blast casualties and of radiation casualties will depend on the actual targeting and on the quantity and quality of protection. Under present conditions of protection an attack aimed primarily at nuclear striking force targets will produce more casualties through fallout than through blast; but, if population is the target, blast casualties will far exceed fallout casualties.

If we introduce the assumption of fallout shelters for everyone, all fallout casualties disappear. On the other hand, the assumption of blast shelters will not eliminate all blast hazards. Blast shelters can very greatly reduce blast casualties, but economically feasible shelters provide no protection for the people who are in the large areas cratered by nuclear detonations. For example, let us assume an attack of about five thousand megatons with multiple target objectives including emphasis on nuclear striking forces and industry and with a high percentage of surface bursts. Under present shelter conditions, the attack will produce about 120 million U.S. casualties including 90 million fatalities. Because of the assumption of a high percentage of surface bursts, about half of total casualties are due to fallout. Therefore, if we assume that everyone has and uses a fallout shelter space, the total casualty estimate falls from 120 million to 60 million. If we go one step further and assume that every one in blast probable areas is in a blast shelter that provides protection up to 100 pounds per square inch, the casualty total is further reduced from 60 million to 10 million. If we try to provide conditions that will save these last 10 million, we must assume that the enemy will avoid striking our population centers or we must assume no nuclear exchange at all.

Distribution of Casualties

Perhaps these very general findings would have more impact when examined in terms of their geographic implication and in relation to other characteristics which I presume would interest a demographer. Casualties resulting from any conceivable type or weight of nuclear attack will not be spread evenly over the population. The post-attack population will have a different age composition, a different geographic composition and a different occupational composition. At this point, we do not have a valid basis for quantifying the differing effects of attack by age group. It is known, however, that the very young and the very old have lower survival potential than the age groups in between. Hence, the post-attack population would be comparatively thin at the age extremes.

The post-attack geographic composition of the population will depend on targeting and other variables already discussed. In general, however, it appears that certain regions will be likely to emerge from an attack with much smaller percentages of their pre-attack populations than the national average. Conspicuous among these are the New England and Middle Atlantic regions, and California. Some estimates, based on present shelter, show New England fatalities to be as high as 75 per cent with an additional 10 per cent injured. The same studies suggest about 30 per cent fatalities for the Rocky Mountain area and 35% for the Southeast. I should add that those studies were based on hypothetical attacks that involved a high proportion of surface bursts, which cause heavy fallout. As a consequence about half of a total of 120 million casualties were radiation casualties. If the percentage of surface bursts were reduced, the numbers of fallout and total casualties accordingly would be reduced.

In general, densely populated regions must be expected to lose higher percentages of their populations than will sparsely populated regions. Therefore, any massive nuclear attack will tend to promote a somewhat more uniform population distribution. Although rural homes generally provide less effective fallout protection than do urban homes, rural residents as a whole are less hazardously situated than are urban residents. Therefore, a massive nuclear attack will reduce the relative predominance of our urban population.

The post-attack labor force available thirty days after the attack probably will represent a significantly

lower fraction of the population than does the pre-attack labor force. Later, the available labor force will make up a larger percentage of the population as a consequence of the recovery of many sick and injured, and as a consequence of the post-attack entry into the labor force of housewives, retired people, and others not employed at the time of the attack.

A nuclear attack can be expected to alter the occupational composition of the labor force. Such alterations are usually ignored by NREC in its estimates of the status of manpower within each metropolitan area following hypothetical attacks. Such estimates are made by means of a computer model which applies the percentages of casualties of various types in each metropolitan area to the occupational distribution of the labor force in that metropolitan area. These results are based on the implicit assumption that each class of manpower is distributed within each metropolitan area precisely in proportion to the total population distribution in that area. We know this assumption to be in error; but we do not yet know how much difference it makes.

Although the gross procedure just outlined ignores differences in the casualty rates among the occupational groups within each area, it does take into account the differences in impact on the various manpower classes that arise from the uneven distribution of each manpower class among cities and the uneven distribution of the attack among cities. Consideration of these factors usually leads to heavier estimates for casualties in the non-agricultural than in the agricultural labor force and to unusually heavy casualties in certain occupational classes such as chemists and chemical engineers, aircraft mechanics, tool and die makers. Certain other skill classes, such as carpenters, auto mechanics, utility linemen and truck drivers, usually fare better than average.

Next, let us consider briefly the distribution of the affected population among health conditions or classes over time. By no means all of the fatally injured will die immediately and by no means all that will become casualties get sick immediately. We have a computer model which "time-phases" the casualties on the basis of time factors provided by the medical authorities. Using these time factors and the computed estimates of the casualties of each type, the computer will provide a distribution of survivors showing the number in each of eight health categories during each of 5 post-attack time periods in each state, each region, and in the country as a whole. Some of the estimates produced by this model have indicated a medical load that peaks at about 30 days after the attack. Sixty days later most of the fatally injured will have died and all but 5 to 10 percent of the sick and injured will have recovered.

So much for the effect of some typical attacks on the composition of our population in terms of age, geographic distribution and skill groupings. There is obviously much more that could be said on any of these matters, but I must now say a few words about the longer term post-attack environment.

Population and the Post-Attack Environment

Before attempting to suggest what the post-attack environment will be like, I wish first to say emphatically that it will not be anything like that depicted in Neville Shute's *On the Beach*. It will be bad enough; but by no means that hopeless.

First, let us look at the physical environment. During the first few post-attack days, large areas of the country will be scourged by raging fires which will burn themselves out and by high levels of radioactive fallout which will decay. Throughout vast areas, people will be forced to remain in the best available shelter for at least two days and, in many places, for two weeks. In some areas affected by unusually high radiation intensities, the residents after emerging from shelter must either evacuate or decontaminate. Those areas which must be either evacuated or decontaminated may represent less than 2% of our total land area but they might include over half of our pre-attack population. Surface burst weapons will leave huge craters surrounded by many square miles of devastation. Radiation in the crater areas will persist at dangerous levels for many months. This condition may lead to the indefinite abandonment of these particular areas for any productive use. To the extent that these craters are in metropolitan areas, this necessity will be awkward.

In many areas there will be difficult problems of survival even after the direct attack effects are largely over. There may be shortages of food in New England, for example, and local shortages at many points elsewhere. There will be temporary problems of sanitation and water, and lesser problems of housing. For many weeks there will be tremendous problems of caring for the injured and sick—complicated by serious deficiencies of some medicines and medical supplies.

I would like next to be able to describe the post-attack ecology; but on this subject our knowledge is very thin indeed. Such evidence as is available suggests that there will be some temporary but serious disturbances of the balance of nature. During the course of experiments by the Atomic Energy Commission with unshielded nuclear reactors, certain types of plant life were found to be more vulnerable than others to radiation. Many types of small animals, comparatively vul-

nerable to radiation, virtually disappeared from one forest area involved in these experiments. Insects, on the other hand, being relatively invulnerable and being rid of preying animals, were observed in increasing numbers.

The post-attack institutional environment will depend on the continuity, resourcefulness, and general effectiveness of our leadership and the survival and resilience of pre-attack institutions, public and private. Undoubtedly some of our leaders will perish and others will fail to meet their responsibilities; but our history suggests that where necessary, new leadership will emerge. Undoubtedly, some of our institutions will undergo unpredictable changes. Those which prove inadequate and unadaptable will be replaced—for better or for worse.

The more complete and realistic our preattack planning and preparations have been and the more effectively the government is at all levels in inspiring and retaining the confidence and support of the population, the less drastic these institutional changes will be. In this connection, much has already been done—for example, it may interest you to note that the Federal Reserve System, in co-operation with the U.S. Treasury, has made rather detailed plans to act promptly in various ways to maintain our medium of exchange and our banking and credit systems. Comparable steps have been taken by many U.S. government agencies in connection with their assigned emergency planning responsibilities to develop the necessary ground work for continuity in government and for effective management and utilization of surviving resources. Let me make clear, however, that there still remains much to be done in the various areas of emergency planning—at state and local levels as well as within the federal government and among private institutions of many types as well as in public institutions.

Let us examine briefly some other facets of the post-attack economic environment. Per capita wealth in material terms may or may not be reduced by the attack. Unless shelter conditions improve, the country probably will lose population roughly in proportion to losses in industrial plant capacity. If, on the other hand, large numbers of people are saved by improved shelter, the surviving plant capacity will be spread more thinly among them. But even so, when one considers the great reserve capacity of U.S. industry, which now operates largely on a one-shift basis, plus the technical competence in its managerial and labor force, one must conclude that the industrial economy can be rather rapidly restored. This is not to say that there will be no difficult problems crying for solution—problems of industrial imbalance, problems of shortage in certain occupational skills, acute problems in restoring communication, electric power transmission and transportation services, and most important, problems of overall co-ordination and integration of the recovery process.

Notwithstanding the bleak picture one must draw of the post-attack environment, few of the analysts who have studied carefully these post-attack survival and recovery problems take any stock in the oft-repeated theory that "the survivors will envy the dead." On the contrary, after a very rough year or two, the surviving population, if it so chooses, can begin to enjoy the advantages of a social structure and a physical environment not so very different from those which prevailed before the attack. ▲

The Emergency Lodging Service *(conclusion)*

(*b*) Policies and procedures operable at the municipal level have been developed and are available in precis form.

(*c*) Six Emergency Lodging Staff Plans and Operations Courses have been held at the Canadian Civil Defence College.

(*d*) Operational forms, Lodging Facility Cards and Assignment forms, have been produced and are being used by municipalities as they develop an operational capability.

Conclusion

Although appalling and enormous in total requirements the task of meeting emergency lodging needs is by no means impossible if a start is made now. Such temporary lodging, made available quickly and adequately during an emergency would be one of the most important factors contributing to national survival and recovery.

Radiation Hazards Control in Survival Operations in the Event of a Nuclear War

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ABSTRACT

The concepts of radiation protection in survival operations are explained, and procedures devised to control radiation hazards for the protection of the population and maintenance of the operating efficiency of survival operations personnel are presented.

Radiation protection is a command function. The medical responsibility is to provide advice on the probable effects of radiation exposure in the light of existing knowledge of these effects in man.

The major hazard is that of external exposure to penetrating gamma radiation. Radiation exposure guides indicate that persons may be exposed to not more than 100 r whole body radiation in a six-week period, or 200 r whole body radiation in a period in excess of six weeks, without loss of operational efficiency. Beta radiation from fallout deposited on skin or clothing may produce burns, but these injuries will not be incapacitating and can be controlled by simple procedures.

The internal hazard is mainly from ingestion of food or water contaminated with radioactive material. For protection, only canned or packaged foods and water from covered or deep wells are consumed during the early days after a nuclear attack.

CONTROL MEASURES directed toward radiation hazards, if properly conceived in advance planning and properly applied during the early days after a nuclear attack, can effectively reduce the toll of radiation casualties and ensure that the operational efficiency of survival operations personnel is maintained. The Rand civil defence report (1957), predicting the consequences of an extensive nuclear attack on the United States, estimated that the total casualties from all causes might be five million with adequate control of radiation exposure, but as high as 90 million if satisfactory control measures were not provided. As noted by another contributor to this symposium, analogous calculations, applicable to Canada, have been made.

Radiation protection is a command function. The military or civil defence commander is responsible for control of radiation hazards just as he is responsible for all other matters pertaining to the health and welfare of persons under his control.

One of the basic rules accepted by both Canadian Army Survival Operations and Emergency Health Services (EHS) is that the responsibility for advice on the probable effects of radiation exposure is the province of the professional medical adviser.

Of necessity, medical advice has been sought from those who have a special competence to assess the accumulating knowledge on radiation effects; the advice received has guided the formulation of doctrine and policies in survival operations planning. It is important that the profession at large have an understanding of how rules and standards for maintaining operational efficiency in the face of radiation exposure have been set and, in particular, the basic assumptions which have been adopted in the light of imprecise data on the effects of radiation in man. It is the intention of this article to explain certain of these assumptions and the philosophy which applies to our responsibility in providing information on which operational or command decisions will be based.

The physical characteristics of the radiant energies released by atomic weapons have been fully explained in articles in previous Civil Defence issues of this Journal and will not be repeated. It is sufficient to recall that the two main components of biological significance are the gamma ray, which penetrates deeply and in humans causes general effects, i.e. radiation sickness; and the beta ray, which does not penetrate and produces specific effects such as skin burns from surface contact and certain of the lesions which may result from internal contamination. The various other types of radiation, such as neutrons, need not be considered as a separate hazard, since for practical

purposes a unit dose of penetrating radiation from any of the weapons sources will have the same effect in producing acute responses.

The unit of radiation dose which is used by the Canadian Services and Emergency Measures Organization (EMO) is the roentgen (r). Radiation-measuring equipment procured by EMO is so calibrated. The accuracy of this unit, and the use of a single unit, are quite acceptable in developing practical guides and planning documents, though other units with more precise definitions are necessary for scientific studies. The term r for roentgen is used in this report as synonymous with the more scientific terms, rad (radiation absorbed dose) and rem (roentgen-equivalent man), since the numerical values for all can be considered equivalent in view of the other uncertainties involved.

National survival is at stake when an emergency situation is precipitated by a nuclear war.

Under conditions of national survival or wartime operations the chief concern is with the effects of acute doses of radiation acquired within a brief period of a few days. The operational significance of radiation exposure is in the production of ineffectiveness which is important from two aspects: reduction of the effective rescue or combat force, and the number of casualties or medical care load.

Radiation exposure in such an emergency will be partly accidental (no control) and partly under a measure of control which must be provided for in advance planning and will be an important factor in guiding operational decision, e.g. in entry and rescue, reoccupation, or transfer of evacuees to uncontaminated or safer environment. Exposure to the initial radiation from weapon detonation and fallout in transit is uncontrollable and, in fact, those so exposed would become fatalities owing to blast and heat effects. Therefore, the concern is with the two types of radiation resulting from deposited fallout: penetrating gamma radiation, and beta radiation as a contact hazard.

Delayed or long-term effects such as those which shorten life, give rise to genetic effects, etc., must be of secondary consideration. This concept is difficult to accept from the medical point of view unless it is realized that we are virtually prescribing for survival of the nation in a most literal sense.

Fortunately, decisions dictated to ensure survival are not in general inconsistent with the reduction of late effects. Measures which aim to reduce casualties will be the same as those which keep late effects to a minimum.

Control of the External Hazards of Gamma Radiation

When radiation exposure from weapons fallout was first considered by those responsible for survival planning, it was difficult to arrive at definite decisions on acceptable exposure levels. The calculations of public health purists who had arrived at safe permissible levels for radiation workers in industry, if applied to survival operations, would have completely obviated any rescue effort. Yet knowledge of the effects of larger doses in man was very sparse. In fact, even current guides are based on rather imprecise knowledge, and are subject to revision as new facts become available. Certain instances of accidental exposure, such as that of the Marshall Islands population in 1954, a few nuclear accidents in industry, and experience from total body therapeutic radiation, have helped to provide some information on responses to radiation in the dosage range producing the acute radiation syndrome and death. Data from animal experiments have contributed, and a great volume of laboratory research is in progress, studying radiation effects and searching for the fundamental mechanisms involved in radiation injury. However, this contribution can only be extrapolated to effects in humans, and only limited confidence can be placed in such evidence.

Our aim is to establish levels of radiation exposure and state the probable early effects on individuals or groups who might represent a rescue force, a military unit, or a section of the population. This aim is part of the traditional medical advisory function within any military or paramilitary organization.

It would be well to discard the term "permissible dose" in survival operations, since it is quite unrealistic to place restrictive rules upon those who will be responsible for command and decision-making in a survival situation. To assist him in dealing with the total operation, the commander needs guide lines describing the consequences of exposure to radiation dosages with which he may be confronted. According to established military principles, the decision to place any individual or group at risk from radiation (or any other hazard), or to accept the probability that a certain number of the forces available will become ineffective (i.e. radiation casualties), must rest with the commanders; only they can weigh the risk involved against the importance of the objective. In survival operations, these decisions apply not only to rescue personnel but also to the total population at risk.

One of the recommendations of the (U.S.) National Committee on Radiation Protection (NCRP) in respect of exposure to radiation in an emergency should be noted: "In war emergencies the objectives are, first,

the fewest deaths; second, the fewest requiring medical care; third, the smallest amount of genetic injury; and fourth, the lowest probability of late somatic effects." Report No. 29 of NCRP states the four elements which are employed in the processing of command decision-making in an emergency as follows: "(1) an input of information; (2) a system for predicting the outcome of any action that may be recommended; (3) a system for assigning values to all such outcomes; (4) a system of criteria for selecting the appropriate action." Items (2) and (3) are the elements for which guidance on radiation effects in man is essential.

Though experts differ in their opinions on the acute effects from certain doses of ionizing radiation in man, all agree that the range 200 to 1000 r covers a spectrum of effects ranging from slight symptoms to death within a few weeks. There is similar agreement that, up to 150 r, no obvious illness will be noted. A number of dose-effect tables have been published for planning purposes; all share the danger of precise interpretation, since they imply an accurate knowledge of exposure effects in man which does not exist. The dose-effect table which is accepted by Emergency Health Services, Department of National Health and Welfare, as a reasonably reliable guide, is included (Table I) since it presumes less than tables published earlier.

TABLE I.—Acute Effects of Whole-Body Penetrating Ionizing Radiations on Human Beings*

Dose in one week	*Effect*
0 - 150 r	No acute effects—some long-term hazard
150 - 250 r	Nausea and vomiting within 24 hours, minimal incapacitation after two days
250 - 350 r	Nausea and vomiting in under four hours. Some mortality will occur in two to four weeks. Symptom-free period of 48 hours to two weeks
350 - 600 r	Nausea and vomiting under two hours. Mortality certain in two to four weeks. Incapacitation prolonged
600 r and more	Nausea and vomiting almost immediately. Mortality in one week

* *From Emergency Health Services Manual, Nuclear Weapons Section, p. 35.*

Caution in the use of this or other dose-effect predictions for planning or operations is indicated in the following provisos:

1. Prediction of dose-effect is only as accurate as the estimate of the dose received. Depending on whether the exposure dose is recorded from a pocket dosimeter or estimated from a report of radiological survey of an area incorporating a protection factor from a type of refuge or shelter, the prediction of dose may have an uncertainty ranging from ± 25% to ± 50%. These uncertainties are mainly due to inaccuracies in radiation measurement instruments under field conditions.

2. The degree of radiation injury in any one individual depends on a number of factors:

(i) The dose received.

(ii) Whether the exposure was partial or whole body, multidirectional or unilateral.

(iii) The period over which the dose was accumulated, i.e. the dose-rate. A given dose received in a short time will be more injurious than the same dose protracted at a lower dose-rate.

(iv) History of previous radiation exposure.

(v) Resistance or susceptibility of the individual to radiation injury.

In formulating radiation exposure guides, the Emgency Health Services and the Canadian Armed Forces have chosen to circulate data on a minimum number of exposure levels and have enunciated certain principles to be considered in conjunction with these data. The probable effects beyond these levels are described in ranges of dosage as in Table I.

The "Rules and Standards for Maintaining Operational Efficiency in the Face of Radiation Exposure" are as follows:

I. (*a*) No one shall be deliberately exposed to irradiation without good reason.

(*b*) The levels of exposure must be kept as low as may be compatible with the success of a useful defensive operation.

(*c*) Responsibility for decision on the need for radiation exposure is that of the commander or coordinator.

(*d*) Responsibility for measurement and calculation of radiation exposures belongs to the technologist (Radiation Monitoring Services).

(*e*) Responsibility for advice on probable effects of exposure is the province of the professional medical adviser.

II. Persons who are exposed to not more than: (a) 100 r whole body radiation in a six-week period or (b) 200 r whole body radiation in a period in excess of six weeks, may be expected to escape without noticeable loss of operational efficiency.

III. As exposure levels increase, the probability of occurrence of operational inefficiency increases until, at just above the upper limits of the ranges cited, some mild reactions can be expected.

IV. Where exposures greatly exceed 200 r for the emergency period, those so exposed must be regarded as radiologically expended; that is, additional exposures at operational levels will probably be followed later by appreciable damage to health.

V. These rules are based on the need for preserving operational efficiency of a limited number of persons.

VI. They are very high levels at best, and those so exposed undergo some risk of becoming late war casualties from various causes, and of suffering a shortening of life-span.

VII. The general public should not be allowed deliberately to accept such high exposure levels. For such groups, 25 r during the emergency period should probably be the upward limit for planning, and for operations, if feasible.

The dose of 25 r cited for the general public may appear to be somewhat idealistic. It is recognized that it will be exceeded under certain radiation conditions, yet careful study of probable fallout conditions offers evidence that it is a reasonable objective for a significant fraction of the population.

The concept of a recovery factor warrants mention. It is accepted that somatic radiation injury is made up of a reparable and of an irreparable fraction. Knowledge of this process in man is incomplete, and any conclusions regarding the amount of irreparable injury and the rate of recovery of the reparable fraction have been based on experimental evidence in animals.

The figures on exposure levels quoted above (100 r in under six weeks and 200 r over six weeks) have taken recovery into consideration. A most conservative estimate of recovery has been used, in view of the other uncertainties such as accuracy of dose and dose-rate estimates. The present state of knowledge does not permit the use, in survival operations, of a more precise quantitative calculation of a biological effective dose incorporating a recovery factor. As further information becomes available, it may be possible to do so, since the value to operational planning is obvious.

Control of the Contact Hazard

Beta radiation from fallout material deposited on skin or clothing is the source of this hazard. The most serious injury which can result is skin burns.

From the point of view of radiation protection, the beta hazard should be considered relative to the external gamma hazard. The beta hazard may cause injury but will seldom be lethal; gamma radiation is the controlling hazard during early days in a fallout field.

The Marshall Islands incident provided useful information on the effects of beta radiation. Conditions were such that an example was provided of the worst possible results of beta radiation relative to gamma, in that the population was unaware of and uninformed about the hazard, decontamination was delayed until two days after the event; and (in that climate) very scanty clothing was worn so that it offered little protection. Varying degrees of skin injury were observed, from superficial to deeper lesions, but none of the exposed population was incapacitated by these injuries.

A survey of the island about one week after the incident led to an estimate that the population received approximately 175 r of gamma radiation. The estimate of beta dose to the skin could not be calculated with any accuracy. It is sufficient to point out that beta radiation injury did occur under conditions of sublethal gamma radiation, and thus to emphasize the need to include protection and decontamination procedures in radiation hazards control.

Measurement of beta contamination under field conditions is impractical because of technical difficulties; therefore the condition will always be presumed to coexist with gamma hazard from fallout, and appropriate control measures should be instituted.

Of a number of factors which govern the probability of skin injury from beta contamination, the closeness and duration of contact of the fallout particles on the skin are the most important. This fact points the way to simple, effective, protective measures which can be easily explained to permit individual action.

Immediate or earliest action to wash exposed skin and change clothing, with controlled disposal of wash water and contaminated clothing, is recommended. Various directives and handbooks offer detailed instructions which are beyond the scope of this paper.

Protective clothing of simple design and ordinary materials will be provided for the use of survival operations personnel. Control of evacuees and others, in and through contaminated areas, is also important to reduce the possibility of beta injuries and to minimize the requirements for decontamination facilities.

Control of the Internal Hazard

This hazard results from radioactive material (a mixture of radioisotopes contained in fallout) which may be taken into the body by ingestion or inhalation. Internal contamination by this material will be less important in the early emergency period after a nuclear attack than the external exposure to gamma radiation, but precautions to limit the amount of radioactive material taken in should be observed, when possible, since serious late effects may result.

The danger from inhalation as the route of entry is a minor one. Evidence available indicates that there could not be a situation in nuclear warfare where inhalation of fallout material would produce acute injury to the respiratory or digestive tract. Such protective equipment as respirators need not be considered.

The main route of entry is by ingestion, and control is a matter of assessing the degree of contamination of food and water. Ingested radioisotopes may be in sufficient concentration to cause injury of the intestinal tract and, if soluble, they will be absorbed to become fixed in certain body tissues and produce damage by continuous irradiation at that site over a prolonged period.

The isotopes which are the main culprits are those which are incorporated into bone, strontium-89, strontium-90, barium-140, and lanthanum-140; into thyroid tissue, iodine-131; and caesium-137, which gives rise to general irradiation in the body including the gonads.

Standards have been set below which food or water may be considered safe for consumption during the emergency period. A method for surveying water and food applicable in the field and valid for the first 30 days after contamination has been adopted by EHS. Until adequate survey procedures can be set up, i.e. during the first few days after the attack, only food stocks which have been in protected storage, or canned and packaged food should be used. The outside of the container of the latter supplies should be cleaned before opening. Water from covered or deep wells would be the safest source during this period.

Iodine-131 in milk is a significant hazard to infants rather than to adults. For this reason, emergency supplies include stocks of canned and powdered milk.

Though the internal hazard can be controlled by advance planning, stockpiling of food stuffs, and by sensible precautions during the early emergency period, EHS must be alert to the possible hazard to health posed by contaminated food and water consumed over longer periods during the late emergency and rehabilitation period. Radiochemical analysis would be required to assess accurately the safety of food and water at later times. It is hoped that further study will permit application of simpler methods, since it is most unlikely that adequate laboratory facilities would be available for some time after the emergency.

Conclusion

Control measures can effectively reduce casualties from radiation exposure and maintain the efficiency of survival operations personnel. Radiation protection is a responsibility of the commander; advice on probable effects of radiation exposure to guide command decision is a medical responsibility.

When the problem is national survival, it is a question of how much radiation people can take; using safe or permissible exposure levels as a guide would impose impossible restrictions on the conduct of field operations.

The "Rules and Standards for Maintaining Operational Efficiency in the Face of Radiation Exposure" which have been recommended by Emergency Health Services for control of radiation exposure of the general public and of civilian and military operational personnel are well conceived, and offer the best advice available in the light of present knowledge of radiation effects in humans.

Do We Want Fallout Shelters *(conclusion)*

versus family shelters. The principal advantages of community shelters over family shelters are less cost for better shelter; wide distribution of shelters and hence a greater likelihood of their being where you are; greater degree of skills and manpower for organization of recovery operations and caring for the injured; major reduction of the moral issue of who gets in; and the positive moral value of a community acting as a community to solve a community problem.

If a fringe area community wants to spend its own or government funds to the extent of $80 to $140 per person now, it can have good to excellent fireproof shelters for everyone in the community, appropriately stocked and equipped, inside of four months. For greater expenditure and longer construction time, the shelters can have a dual-purpose use as recreation centers, enlarged school cafeterias, etc. The cost and construction can be spread over a period of years with the hope that war won't occur before the shelters are built, or afterwards either. If we do nothing but hope, however, and war does come, it will be worse without shelters.

If the cost of good shelter is considered too high, modest amounts can be spent to improve marginal shelters. But it is unwise to spend very much this way, for extensive modifications may cost more than new single-purpose shelters. Another course of action is to subsidize the additional cost of new construction to upgrade its shelter potential; the additional cost is relatively small during construction.

No one should infer that shelters represent the only problem in our international affairs. If we survive our present nuclear peril, there are other problems. But if we are to solve these problems, we must be alive to do so. Shelters are a form of insurance. We intend to prevent a tragic nuclear holocaust, but if we should not and if we have shelters, some of our people will survive to begin anew to work for a better world. ▲

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EMO PUBLIC INFORMATION

RADIO AND TV SCRIPTS

A series of 50 radio/television scripts on the subject of Public Survival have been made available to each Provincial Coordinator for possible adaptation by provinces and municipalities.

The series consists of three phases. Phase 1 is 12 scripts dealing with 11 STEPS TO SURVIVAL. Phase 2, consisting of 10 scripts, covers the survival plan for each municipal department. The remaining scripts are devoted to a question and answer format titled EMO QUESTION TIME which encourages audience participation.

The scripts were prepared by Mr. Gerard Bowers, City/County Coordinator of EMO Kingston/Frontenac, and presented weekly over Radio Stations CKWS and CKLC, Kingston. The scripts also were presented "live" over CKWS/TV, Kingston. It is understood that other Ontario municipalities are planning to adapt these scripts for local use.

Municipalities interested in these scripts should write to their Provincial Coordinator.

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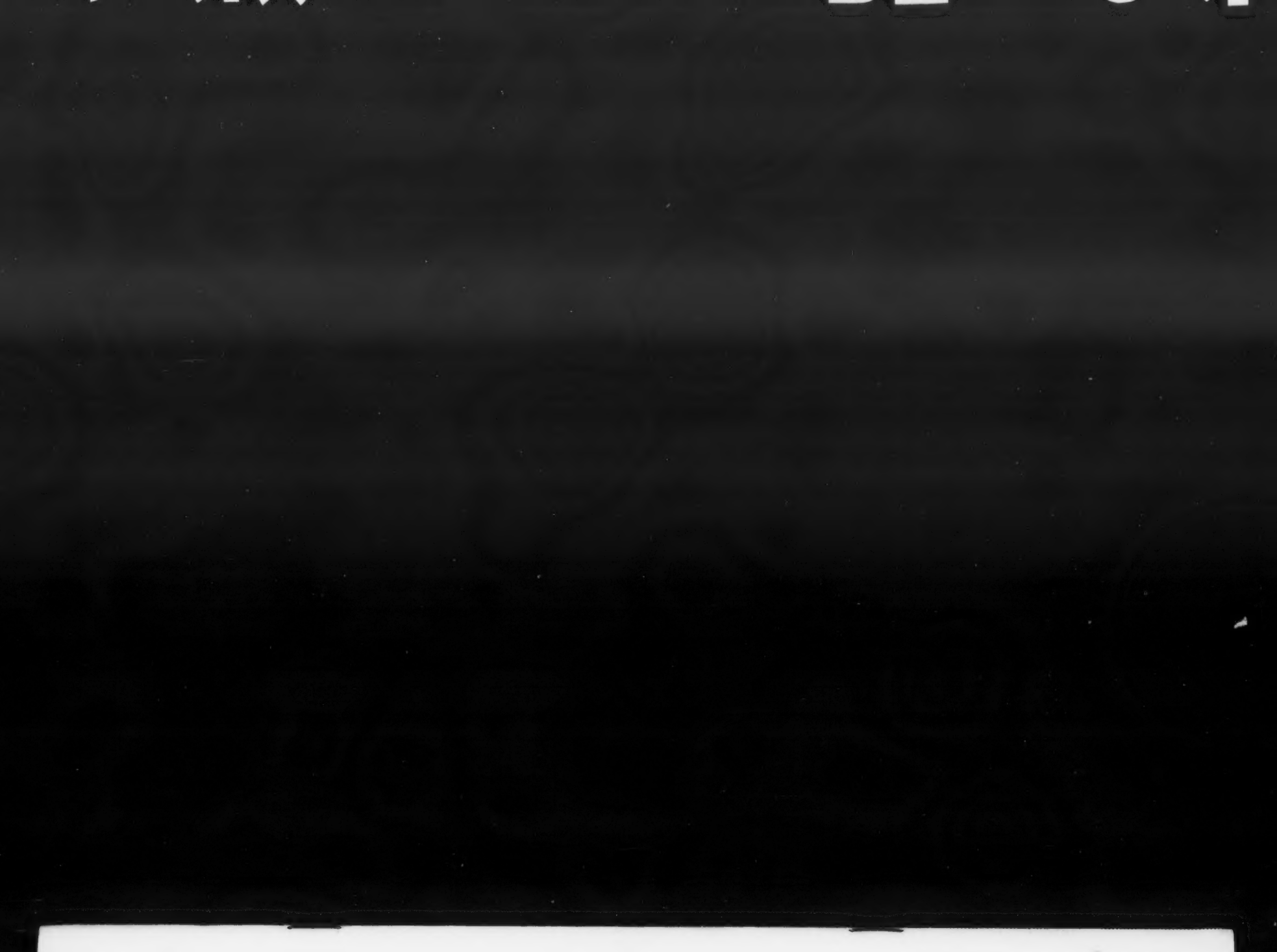
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